Cement MILL SECTION of

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The Cement Industry in South Africa

By M. C. Bird
Secretary, Pretoria Portland Cement Co., Ltd.

The Pretoria Portland Cement Co., Ltd., established in 1892, then known as the First Portland Cement Factory, Ltd., began operations with a small shaft kiln plant producing a few hundred bags per month. But, in spite of assistance from the Republican Government in the form of a protective tariff and the fact that imported portland cement was almost unattainable, except at a very prohibitive cost, little progress was made. The industry, although enlarged to some extent, enjoyed only a struggling existence, no doubt due mainly to the antiquated method of manufacture, and was virtually in a state of collapse when reconstruction and revised administrative methods were adopted.

In 1904, the company, under its present name, introduced the use of a rotary kiln, imported from the Bonnot Co., of Canton, Ohio, U. S. A., and subsequently added other improved untis of more modern type.

Appreciable progress and success attended the improved method of manufacture, which, coupled with

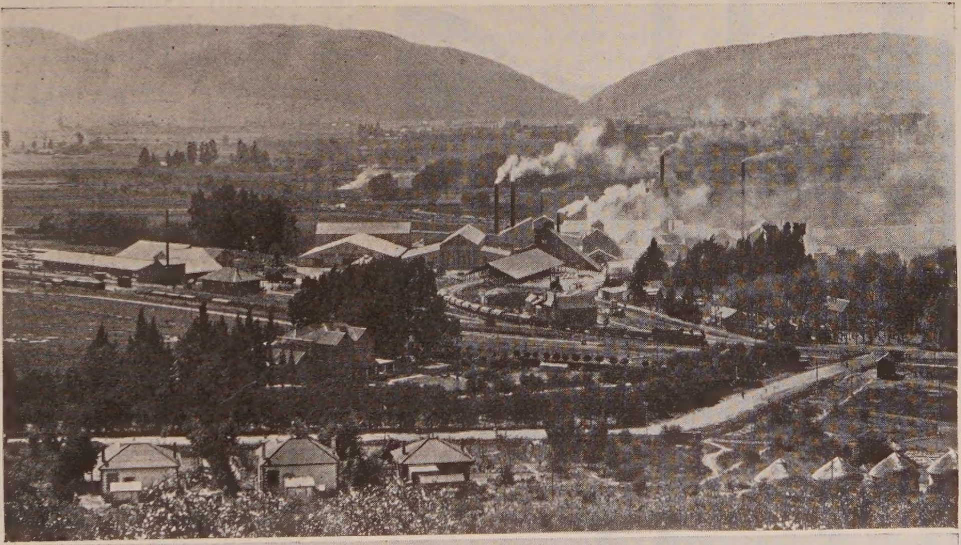


Fig. 1—General View of Works, Hercules, Pretoria

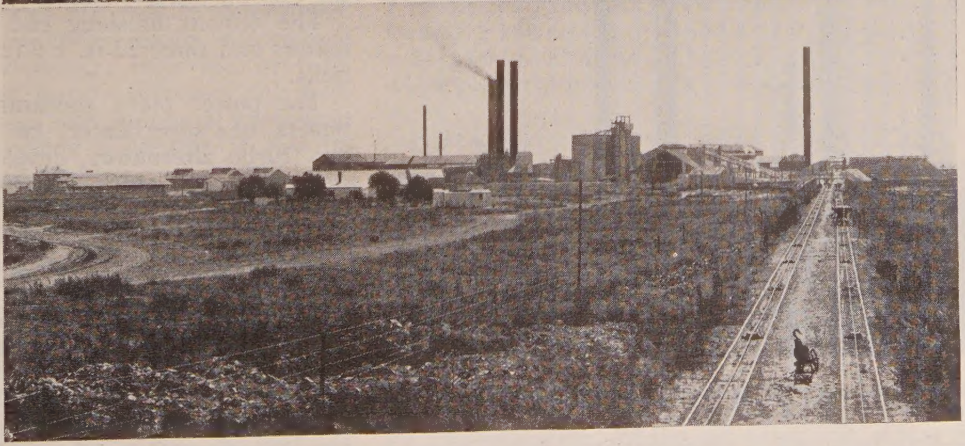


Fig. 2—General View of Slurry Works

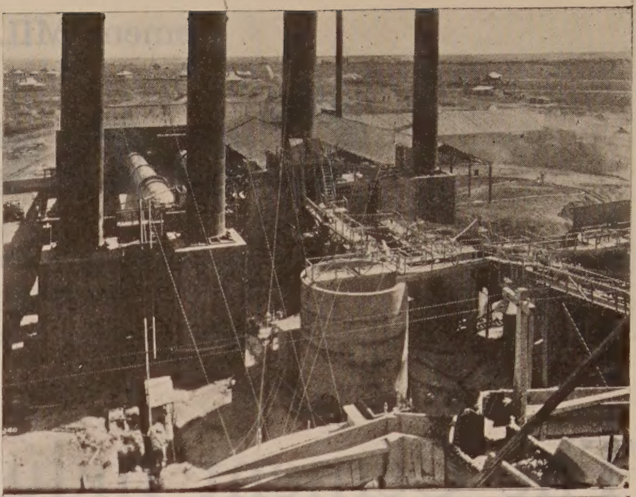
an increasing demand from every quarter, encouraged the company to undertake considerable expansion and additions to this plant. Today, the productive capacity of the company's factories exceeds 3,000,000 bags (of 190 lb. each) per annum, equivalent to about 1,500,000 casks, which reflects a little of the advancement made by what is recognized as one of the leading and most successful of South African industries.

The company operates 2 factories constructed and equipped on the most modern and improved lines, electrically controlled. The one situated at Hercules, Pretoria (dry process), the original site of the company's operations, and the other at Slurry, near Mafeking (wet process), which was erected in 1915 and is today the largest portland cement works operating in South Africa. Readers will no doubt notice the familiarity of the names adopted, which bear a close relationship to the industry generally.

The limestone deposits owned by the company are of very high quality and almost unlimited extent. The quarries are conveniently situated for each factory. Gypsum is also quarried on one of the company's properties within reasonable distance of both factories.

"Pretoria" portland cement has been used on the largest concrete constructions recently accomplished in South Africa, which compare favorably with the world's finest examples of engineering feats in modern cement-concrete work. These include irrigation works, graving dock and harbor works, bridges, railroad construction, Government buildings, etc., all of which have proved the high uniform qualities of Pretoria cement, a guaranteed standard brand.

The Pretoria Portland Cement Co. is capitalized for £630,000 in £1 shares. The shares are held locally and the company is under English control. The main office is in Johannesburg, Transvaal, E. Davidson is manager, and M. C. Bird, secretary.



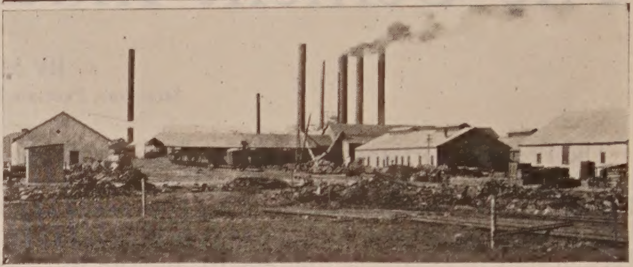
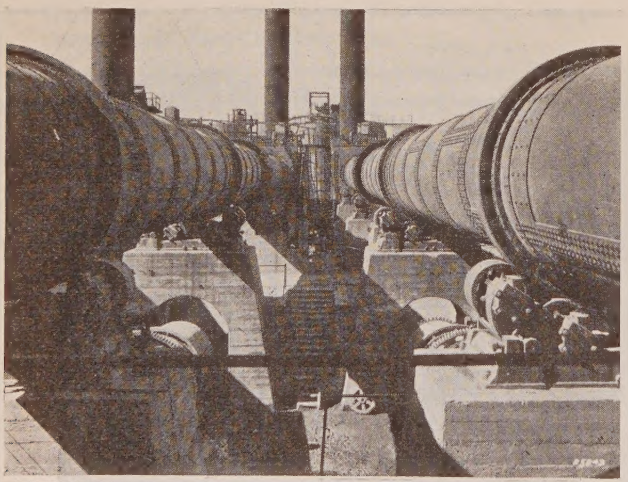


Fig. 5—Burning Department, Slurry Factory, Showing Full Complement of Rotary Kilns and Silos, Before Being Completely Housed in

Fig. 6—Shops and Power Plant. Slurry Factory



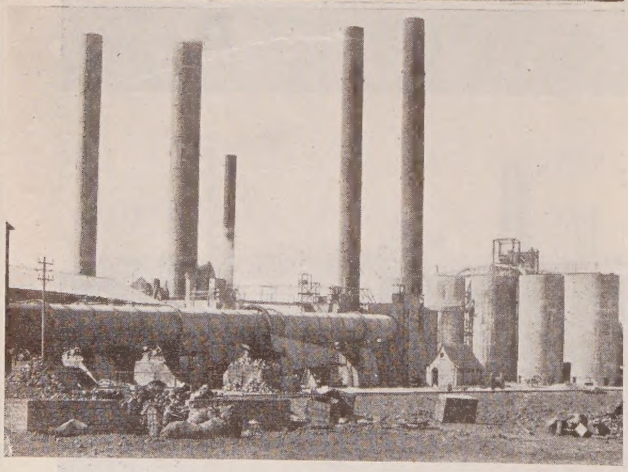


Fig. 3—View of the Two 200 ft. x 9 ft. Rotary Kilns, Slurry Factory, Previous to Being Housed in

Fig. 4—View Showing Kiln and Slurry Silos, Slurry Works

Hercules Factory

The Hercules factory, loacted on the outskirts of Pretoria, operates under the dry process, with an output of 90,000 bags, of 190 lb. each, per month, equivalent to 45,000 casks. The raw end equipment includes: two Gates crushers, Allis-Chalmers rotary dryer, Krupp ball mill, five 33-in. and three 42-in. Fuller-Lehigh mills.

The clinker is burned in two Allis-Chalmers rotary kilns, 8 ft. in diameter and 125 ft. long. A Mead-Morrison link bucket clinker conveyor handles the clinker from two 60-ft. x 6-ft. Allis-Chalmers rotary clinker coolers to two steel cylinder storage tanks, 50 ft. in diameter and 31 ft. high.

Coal is used for firing the kilns. One Allis-Chalmers coal dryer and two 33-in. Fuller-Lehigh mills prepare the coal for firing the kilns.

The cement finishing end consists of two preliminators and three 22-ft. x 6-ft. Allis-Chalmers slug-peb mills.

The power plant contains five 250 h.p. Sterling boilers, one superheater, two 750-kw. and one 1500-kw. turbo alternators, developing 3-phase, 50-cycle, 2200-volts alternating current.

Slurry Factory

The company's wet process plant is located at Slurry, 176 miles from Johannesburg and 14 miles from Mafeking, Bechuanaland. The output of this plant is 160,000 bags, of 190 lb. each, per month, equivalent to 90,000 casks.

In the raw end of this mill, there are two Gates crushers, four Allis-Chalmers No. 85 preliminators, two classifiers, four 5-ft. x 22-ft. Allis-Chalmers slugtube mills and five compressed air agitated correcting and stock slurry tanks, 20 ft. in diameter x 50 ft. high.

The kilns in this plant are larger than at the Hercules factory. There are four Allis-Chalmers rotary kilns, two 9 ft. in diameter x 160 ft. long, and two 9 ft. x 200 ft. long. The clinker passes into three Allis-Chalmers clinker coolers, and is conveyed by Link-Belt clinker conveyors to three steel stock bins, 50 ft. in diameter x 31 ft. high.

Coal grinding for the kilns is done in four 42-in. Fuller-Lehigh mills, after the coal is dried in two Allis-Chalmers dryers. The finished grinding end for the cement is equipped with four No. 85 Allis-Chalmers preliminators and four 6 ft. x 8 ft. slug-peb mills of Allis-Chalmers manufacture.

The power plant contains five 250-h.p. Sterling boilers, one 300-h.p. Babcock & Wilcox boiler, chain grate stokers, one superheater, two 2000-kw., one 1000-kw., and one 500-kw. turbo-alternators, developing 3-phase, 60-cycle, 600-volt alternating current.

All cement at both plants is packed in jute bags received direct from India.

Cape Portland Cement Co.

Affiliated with the Pretoria company is the Cape Portland Cement Co., which was established in 1921 and began operations in 1922, using the dry process. This factory is located at De Hoek, 104 miles from Cape Town, and has an output of 70,000 bags per month, equivalent to 35,000 casks.

The capital of the Cape Portland Cement Co., Ltd., is £350,000, consisting of £1 shares. The head office of the company is in the Argus building, Cape Town.

Details of Plant

One No. 8 Gates crusher, an Allis-Chalmers rotary dryer, one Krupp ball mill, and five 42-in. Fuller-Lehigh mills make up the equipment of the raw end. Clinker is burned in one Allis-Chalmers rotary kiln, 160 ft. long x 9 ft. diameter, which discharges into a 60-ft. x 6-ft. clinker cooler.

Coal for the kiln is prepared by one Allis-Chalmers dryer and three 42-in. Fuller-Lehigh mills.

The cement finishing end comprises two No. 85 preliminators and two 18 ft. x 6 ft. slug-peb mills—all Allis-Chalmers make.

The power plant contains two 700-h.p. Babcock & Wilcox chain grate boilers with internal superheaters, a Green fuel economizer, two 750-kw. Bellis & Morcam turbo-alternators, delivering 3-phase, 50-cycle, 2200-volt alternating current.

Cement Burning—Discussion

By C. O. Sandstrom

In an interesting article on "Cement Burning," published in the August number of Concrete, Mr. Meade invites discussion of the subject, together with its attendant operations. He outlines the results of much observation and practice in the field under discussion, and mentions a number of points on which there is some difference of opinion. As honest difference of opinion exists because of inability to see the light or, in a still greater degree, *lack* of light, the slogan in all matters of disagreement should be: Let there be more light!

Mr. Meade is uncertain of the economy of the rotary cooler. Whether a clinker cooler is a good investment can be determined by the answers to the questions: Does the heat recovered from the clinker and returned to the kiln pay the cost of operation and a satisfactory rate on the investment? Is the heat actually utilized, or does it merely raise the stack temperature?

There should be little trouble in answering these questions, as the quantities are readily determined. Unless the installation of a cooler results in increased kiln capacity, or fuel economy, then the heat recovered from the clinker merely increases the temperature of the stack gases and, unless a waste-heat boiler or other heat-absorbing apparatus is also installed, the investment will be a loss.

A sure way to settle the question is to conduct comparative tests of the kiln with and without cooler. In the absence of complete tests, however, it would seem that the temperature of the air entering the kiln furnishes the data necessary to determine whether the cooler is a paying investment. If the heat returned to the kiln by the cooler is sufficient to pay for its installation, and it is found that the overall efficiency has not been increased, then the fault must lie, not with the cooler, but with kiln operation. All that can be expected of the cooler is that it furnish heat sufficient to pay a fair return on the investment—failure to use the heat efficiently is chargeable to kiln operation and should not condemn the cooler.

Let us see what a calculation discloses with respect to cooler operation. We shall assume a kiln of 600 bbls. daily capacity, and a heat consumption of 1,400,000 B.t.u. per bbl.; this is 112 lb. of coal containing 12,500 B.t.u. per lb. At 600 bbls. per day, the hourly output is 25 bbls., and the coal consumption 2800 lb. per hour. The heat given up by the clinker in cooling from 2000° F. to 150° F. (assuming a specific heat of .21) is 25 x 376 (2000 — 150) .21 = 3,650,000 B.t.u. Allowing a 10% loss by radiation and convection from the cooler (a crude way of expressing the loss, by the way), the heat available for raising the temperature of the incoming air is 3,285,000 B.t.u. This heat is the equivalent of 263 lb. of 12,500 B.t.u. coal per hour, or 3.15 tons a day, or 945 tons a 300-day year. At $4 a ton, the gross saving is $3780 a year. Allowing $7 a day for operation, this charge for the year is $2100, leaving a net return of $1680 a year, which is 15% on a $11,200 investment. This indicates that the cooler when properly installed is a desirable piece of equipment.

A study of the rotary cooler brings to light some interesting features. I have seen published statements to the effect that temperatures of upward of 900° F. of the air leaving the cooler have been observed. If this is the actual temperature of the air, then its volume must be a fraction of that necessary for the combustion of the kiln fuel. The air theoretically required for combustion is about .75 lb. per 1000 B.t.u. of the coal. With an allowance of 20% excess air, 1 lb. of coal will require $.75 \times \frac{12,500}{1,000} \times 1.2 = 11.25$ lb. of air for its combustion. In the last paragraph, it was shown that the coal consumption of a 25-bbl.-a-day kiln was

2800 lb. an hour. At 11.25 lb. of air per lb. of coal, Gal. 15—13127—Nov. Concrete—10 337——Irving— the air required is 25 x 112 x 11.25 = 31,500 lb. per hour. If 10% of the air required for combustion is blown into the kiln with the fuel, then the temperature of the remaining 90%, or 28,350 lb., would be raised by the 3,285,000 B.t.u. available in the clinker $\frac{3,285,000}{28,350 \times 24}$ = 483°F. With the atmosphere at 70°, the temperature of the air entering the kiln would be 553° F.

A temperature of 553° of the air entering the kiln is so much lower than is sometimes stated that an explanation seems desirable. While it is very difficult to limit the air entering the kiln to that coming through the cooler, the high temperatures reported by different observers cannot be ascribed entirely to a small volume of air acted upon. The observed high temperatures can, I think, be attributed largely to the influence of the red-hot clinker on temperature measurement. Whether the temperature is taken at the cooler or in the opening in the floor leading to the cooler, radiation from the hot clinker is certain to give an exaggerated temperature reading. It would seem that to avoid this and get the correct temperature of the air, the kiln should be stopped long enough to enable the cooler to move the hot clinker out of the range of possible influence on the temperature reading. Incorrect temperature readings could easily be the cause of disappointment in the operation of clinker coolers.

The benefit from preheating the air to the kiln is not alone that represented by the heat content of the air, but includes also the acceleration effect on chemical reactions. If a certain operation requires heat at a temperature of 2500°, all the heat in the world at 2000° will not avail.

A rotary cooler to be most effective should be provided with an air-seal, and should also be lined to reduce the loss from radiation. Before lining the cooler, however, it should be determined if the saving effected will justify the cost.

Radiation Loss from Kilns

I think that the loss by radiation from kilns has been greatly exaggerated. Statements are frequently made that from 20 to 30% of the heat of the fuel is lost by radiation and convection from the kiln shell. A simple calculation will show that any such loss is improbable. The size of the kiln of 600 bbls. capacity used in the foregoing example is 8 ft. x 125 ft. The coal consumption was 2800 lb. per hour, and the heat value of the coal 12,500 B.t.u. per lb. Twenty per cent of 2800 lb. of coal is 560 lb., the heat value of which is 7,000,000 B.t.u.; this is the assumed loss from the kiln shell. The area of the shell is 3180 sq. ft. The average loss per sq. ft. is then $\frac{7,000,000}{3,180}$ = 2200 B.t.u. per hr.

It may be well to pause and reflect a few moments. Everyone is familiar with the steam-heating radiator. It emits about 250 B.t.u. per sq. ft. per hour. The heat emission from the upper end of a rotary kiln with a 6-in. lining probably does not equal the emission from a steam radiator, but for this discussion we shall assume that it does. It was shown that the *average* emission from the kiln shell was 2200 B.t.u. per sq. ft. per hour. The maximum emission then is 2 x 2200—250 = 4150 B.t.u. per sq. ft. per hour at the lower end of the kiln. The data I possess on heat emissivity is confined to small surfaces (steam pipes), and is limited to a few hundred degrees of temperature, so I do not know what value to assign in the present example. One can be assured, however, that a surface the size of a rotary kiln, emitting 4150 B.t.u. per sq. ft. per hour, must be nearly, if not quite, red hot.

As anyone familiar with rotary kilns can testify, such temperatures as demanded by the foregoing emissivities do not exist. While the senses are not to be regarded as accurate instruments of measurement, I think that anyone who has touched with the fingers a kiln shell at various places along its length, will be willing to wager that the shell is never hot enough to emit heat in quantities varying from 250 to 4150 B.t.u. per sq. ft. per hour, which is necessary to cause a loss of 20%. In the absence of dependable information, I would state the loss by radiation and convection from kilns as 10%, and from coolers 5%, and feel moderately secure.

Whether to insulate a portion of the kiln to reduce radiation loss can be decided only after a study of the economics of the question. If the heat saved and delivered to waste heat boilers will pay a fair return on the investment, the insulation should be used. Insulating a kiln that does not discharge its gases to heat absorbing apparatus would, however, pay a very small return on the investment as the principal effect would be a needless increase of stack temperature.

Draft Pressure

The draft pressure under which kilns operate varies, as do kiln operators. Judging from reports, the draft practice of steam boilers has been carried into kiln operation. We read of .3-in. pressure at the hood, which is boiler furnace requirement to overcome the resistance offered by the grate and fuel bed. The rotary kiln has few draft requirements that compare with steam boiler practice. There is no grate resistance to overcome, and the resistance offered by the kiln itself is but a fraction of the resistance of boiler tubes. The kiln is merely a flue, and a much larger flue than would be furnished in boiler practice for the same fuel-burning capacity. It would seem that if the following draft losses were provided for, kiln stacks would not give a cement plant the appearance of a central power station.

Draft pressure to overcome resistance of cooler and connection	0.1 in.
Draft pressure to overcome resistance of kiln	0.05 in.
Draft pressure to overcome resistance of baffle in stack chamber	0.05 in.
Draft pressure to provide velocity (velocity head)	0.05 in.
Draft pressure required at base of stack	0.25 in.

I would say that a stack that provides a draft at its base of .3 in. of water is ample for any demand that might come on a cement kiln. A kiln stack 40 ft. high above the top of the dust, or stack chamber, will provide sufficient draft; and for a kiln 8 ft. in diameter, a net diameter of stack of 4 ft. 6 in. will be ample for capacity. It must be understood, however, that a 4 ft. 6 in. x 40 ft. stack will not satisfactorily serve a kiln that projects into a stack chamber with several inches clearance between it and the brickwork, and which chamber has a clean-out door at its base that is usually kept open. These checks on draft must be compensated for by added height and diameter of stack. Where, for any reason, the dust from the kiln stack must be diffused over a large area, the necessary draft is not the determining factor.

A little more thought should be given the opening in the firing floor leading to the cooler. In some installations, the size of the opening is inadequate to pass the required volume of air with the available draft. Dissatisfaction with the performance of the cooler might be traced to this restricted opening. To properly serve an 8 ft. x 125 ft. kiln, this opening should have an area of 12 sq. ft.

Coal Blast

There is much diversity of opinion regarding the correct amount of air to introduce with the pulverized coal. The ideas on the subject vary between a blast of just sufficient volume to move the coal, to enough for complete combustion. Of course, where a cooler is installed, the blast used should not be enough for combustion, as then the air coming from the cooler would be so much excess. As a matter of fact, unless air is prevented from entering the lower end of the kiln by means of seals, it would be impossible to limit the air entering the kiln to that coming in with the coal, because the ejector action of the blast would induce a flow of air through any opening that may exist

I can see no advantage in using a large volume of air for blowing coal into a cement kiln. The argument used in defending the practice is that more complete combustion results. There is little difficulty about obtaining complete combustion in cement kilns. I have never heard a complaint on that score. The time element is greater than in boiler practice, and the kiln does not have the comparatively cold surfaces that exist in a boiler setting; in fact, from the standpoint of combustion, the rotary kiln, because of the large volume that serves as combustion chamber, is practically ideal. As all kilns are provided with stacks more than sufficient for draft needs, and as only a small amount of air is necessary to move the coal, and complete combustion being easily obtainable, why burden oneself with a fan much larger than necessary, with the resulting increased power consumption? I can see no reason for blowing in with the coal more than 10% of the air necessary for combustion.

Admitting a small amount of air with the coal, and depending on stack draft to bring in the remainder through the cooler and between the end of the kiln and the hood, makes working conditions more comfortable about the lower end of the kiln.

In discussing the coal blast, it seems customary to assume that the pressure required is 4 in., 6 in., 8 in., etc. Stating the pressure without also stating where it is taken; and whether it is the total, the static, or the velocity pressure; and also the diameter of the blast pipe, is meaningless. It is a common practice to run the fan at a speed that will give a pressure arbitrarily assumed, in a blast pipe of diameter also arbitrarily assumed. The fact that these installations, with air velocities varying between extreme limits, operate successfully, is proof that there is a great deal of latitude in the choice of blast velocities.

It seems that the logical procedure is to arrive at a satisfactory velocity of the air which, if the volume of the blast has been determined, also fixes the diameter of the blast pipe. The total pressure is then the velocity pressure, plus the static, or friction pressure of the system.

In designing blast systems, consideration should be given the time necessary to accelerate the coal from a state of rest to a maximum velocity. As the time element is an important one, the blast pipe should not be too short. This fact can be made easily understandable by comparing the velocities of rifle and pistol bullets; the rifle bullet attaining a greater velocity because of the longer barrel.

Kiln Diameter and Length

There is some discussion of the proper ratio of length to diameter of kilns. This is not entirely a problem in technology—it is related more to economics. The best ratio must be determined from consideration of the raw material, and the quality and price of fuel, which makes the question a different one in each locality. Lengthening the kiln increases the capacity and the thermal efficiency within certain limits. In increasing the length of the kilns, the point at which the increase of earnings stops is probably reached before serious mechanical difficulties present themselves. Increasing the diameter increases the capacity but not as the square of the diameters, as is sometimes thought. I know of an instance where a large kiln was expected to give a capacity increase over the other kilns in the plant based on the squares of the diameters, and much disappointment was expressed at its failure to perform as hoped. Capacities seem to vary directly as the diameters.

Heat Transfer

Mr. Meade states that "The transferring of heat takes place from the gases to the cement mix and to the walls of the kiln, the heat being transferred from the latter again to the mix; so that the mix is heated in two ways—by the products of combustion directly and through the walls of the kiln." There is no doubt that such heat transfer takes place in the upper portion of the kiln, but I question the accuracy of the statement when it refers to the lower portion. Here the mix makes a closer approach to the temperature of the gases than does the kiln lining, because it is constantly receiving heat while the lining receives heat during only two-thirds of the revolution of the kiln because of the insulating effect of the raw material which covers the other one-third. Also, any loss of heat from the mix is to the lining, while the lining is constantly losing heat to the outside air through the shell by radiation and convection.

Random Observations

A uniform feed of the raw material to the kiln is important. The burner probably has enough to do without imposing a fluctuating feed caused by "hang-ups" and defective feed mechanism. The result on output and quality caused by a "feast and famine" delivery of raw material can readily be imagined.

I think that undue importance is sometimes attached to fine grinding of coal. Recent experience in the power field has shown that the "less than 1% moisture and 85% through a 200 mesh" requirements are uncalled for. And the rotary kiln is better adapted to the combustion of pulverized coal than is a steam boiler furnace.

Some confusion exists regarding the proper direction to "cut" the kiln rolls to make the kiln move up or down on its axis. Often the adjusting nuts on one side are slacked, and if the desired result is not obtained the opposite nuts are slacked. A few operations like this with some kiln may let it down so that the tops of the teeth in the girth-gear ride on the rim of the pinion and which will necessitate the kiln being jacked up in order to correct the trouble. The confusion can be attributed to the circular form of the tire. Anyone moving a timber on rollers can tell at a glance which direction to "cut" the rollers in order to change the direction of travel. The kiln tire is this "timber" except that it is in the form of a circle and which gives rise to the confusion. If, when about to check the upward or downward movement of the kiln, we imagine the tire circle straightened out, then there should be no more difficulty in deciding which rolls to move than in the case of a timber.

I think the practice of grouting in kiln linings is a waste of material and labor. It requires no great stretch of imagination to visualize the effect of the high temperature on the water of hydration of the cement mixture. In a short time the grout is reduced to dust, having no effect that could not be accomplished by the raw material and the clinker dust working naturally into the cracks. And the brick itself is certainly not improved by the water absorbed from the grout. Skutching irregular blocks to obtain a good bearing is all that is necessary.

Some Notes On Waste Heat Boilers

By C. H. Sonntag

The advent of the waste heat boiler has been the outstanding feature of cement mill practice in recent years. Translated into dollars and cents, it has been far more important than the marked increase in the size of grinding units that has also been in evidence. A large granulator or fine grinder may take the place of several smaller machines, and because the new units are proportionately more heavily constructed than their predecessors, lost time on account of repairs will probably be lessened. Still, when the last word is said, these big machines are only replacing others which, while smaller, were doing their work with fair satisfaction. The waste heat boiler, on the other hand, is a distinctly novel development, doing its work with heat that formerly was completely wasted, and so adding a definite increase of revenue to incomes that needed the increase.

Plants having only two, three, or four kilns constitute a large proportion of the producers of today. This does not mean that the average mill is getting smaller, for such is, of course, not the case. It does mean that the production that once was obtained from a long row of 60- or 80-ft. kilns can now be had from a much smaller number of units ranging from 125 to 240 ft. long. In such plants, the kiln room is usually the "neck of the bottle" through which production must flow, and, as a consequence, continuity of kiln operation has become a thing greatly to be striven for. If the gas from these kilns is passed through boilers, the shut-down of a kiln means a loss of power, and this in turn causes a shut down in some other part of the mill, usually in the raw or finish grinding. The tendency is to throw these time losses into the finishing mill, unless the raw grinding department is more than ample to keep a full supply of feed ahead of the kilns. But, however handled, these losses of time are disturbances of mill routine, and hence to be avoided if possible. It has followed that operators are studying as never before such things as life of lining, design of the kiln drive, air supply, coal and raw feeding devices, and especially hot clinker removal. In addition to these are the troubles that affect the waste heat department, such as flue stoppage, fan erosion, baffle failure, and tube leakage.

It is not within the scope of this paper to discuss delays in the kiln room proper. It may be pointed out, however, that this department has a heavier responsibility resting upon it than ever before, and if some faulty piece of equipment or method of operation is causing undue lost time, the expenditure of considerable money to remedy it is justified. Any plant accountant can figure out the ultimate cost of shutting down one of the kilns in his own plant half an hour a day. If every item of cost that is affected is considered, the result will be found to be quite interesting, and may be used as a basis on which to calculate the investment that would be warranted to correct the situation. The figures will be still more startling if the cause of lost time is something that affects all the kilns at once—for instance, a weak system of removal of hot clinker from all of the kilns.

Getting down to the waste heat plant itself, there are four major reasons for taking a boiler out of service. They are:

(1) Troubles due to impure feed water.
(2) To repair baffles.
(3) To remove dust accumulations.
(4) To repair the fan.

Feed Water

It is almost unbelievable that boilers so important to plant operation should be fed with hard water. Yet the writer has seen it done, and some mills may still be doing it, in spite of the fact that there are at least two processes of water softening on the market, either of which is relatively inexpensive, and will furnish feed water so soft that boiler cleaning is practically done away with. Putting a turbine or mechanical cleaner through a 300 or 400 h.p. boiler is bad enough, but when the boiler is rated at 700 to 1000 h.p., the job is not only a hard one, but time consuming. Then, too, the natural unwillingness to shut down and clean out leads to keeping the boiler in service too long, with the inevitable result, a burned and leaky tube. Then to the job of cleaning a very dirty boiler is added that of tube renewal. The equipment that the writer described some time ago[1] went through this experience, one tube being lost and cleaning three or four times being necessary. After the last cleaning, a good softening plant was put into service. No scale is now forming, and such as could not be removed by hand is rapidly disintegrating and passing out. A good softener is almost as important as the boilers themselves, and costs a great deal less money.

Baffles

The use of monolithic baffles is becoming quite common. They have the advantage that they may be placed in almost any position, so as to give the gas passages any desired shape. They are mixed to about the consistency of concrete and worked around the tubes into forms previously placed. The forms burn out when the boiler is fired up, and the baffles are hardened by the heat.

These baffles are subjected to far more severe service than is required in a direct fired boiler. The gas travels at a very high velocity, it carries a heavy burden of gritty, abrasive dust, and there is considerable difference in the pressure on the opposite sides of the baffle. The effect is that of a sand blast, and every little crevice around a tube through the baffle offers a short-circuiting path which may be eroded into a larger opening by the dust carried through it. The writer's experience has been that the baffle is the weakest part of the waste heat layout, as it cannot be repaired without a complete shut down. There is perhaps some compensation for this in the fact that a boiler will operate with quite fair efficiency even when the baffles are not in very good shape. As a kiln will not run indefinitely without relining the hot zone, baffle repairs can frequently be postponed until the corresponding kiln is lined, and both jobs can be done together. A reliable indication of baffle failure is a gradual increase in the temperature of the gas leaving the boiler, and this is in evidence almost as soon as the flames can be seen passing through the holes in the baffles by the boiler operators. This latter observation cannot be made unless the kiln is fired quite heavily.

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[1] "The Waste Heat Boiler Plant of the Cape Girardeau Portland Cement Co." Paper read before the Portland Cement Association, Nov. 1922.

At this point, a word of caution as to the use of tube cleaners in boilers having monolithic baffles may not be amiss. The cleaners that use a purely rotary motion of the cutters do not vibrate the tubes badly, but neither are they very effective in thick, hard scale. In such cases, the operator is tempted to hurry things along by fitting the cleaner with a head that removes the scale by chipping or by rapid hammer blows. These vibrate the tube quite strongly, and the baffles will be so shattered that they will fail badly soon after the boiler is put into service. The use of cleaners of the vibratory type should not be permitted.

Dust Removal

The amount of trouble, or the lack of it, that is had with dust accumulations depends largely on how heavily the kilns are fired. Before the advent of the waste heat boiler, when kilns were operated with natural draft, it was not considered good practice to force a kiln to the point where much carbon monoxide was evolved, to be burned in the stack base with the air drawn in through the unsealed opening around the end of the kiln. Under such conditions, the dust was light and practically non-coherent, and could easily be drawn off through the bottom of a hopper. If kilns feeding waste heat boilers were fired on this same basis, dust troubles would be comparatively trivial. But the use of seal rings around the end of the kilns has increased the gas temperature by preventing dilution by cold air coming in around the end of the kiln. Again, the seal ring compels the suction fan to draw all the air it inhales through the kiln itself. This increases the draft of the kiln, draws more air in at the lower end, and so permits more coal to be burned without the formation of carbon monoxide, but at the same time increases the temperature of the gas leaving the kiln.

The change in conditions of kiln operation sometimes goes farther than this. It may be that, because of old and uneconomical units in the power house, the kilns when operated at the old natural draft rating do not furnish enough steam to run the mill. The first thought would be to keep enough direct fired boilers in service to make up the deficiency. On the other hand, it may be said that since the waste heat boilers are already under steam, the logical thing to do would be to force them enough to get the needed additional steam. This can be done by the simple process of turning more fuel into the kiln. The result, beyond a certain point, is the formation of carbon monoxide, which burns in the flue between the kiln and the boiler with such air as leaks into the setting through the seal ring and other openings. Under such conditions, temperatures above 1800° F. are common at the entrance to the boiler.

The particles of clay in the dust carried out of the kiln are somewhat sticky at this temperature, and adhere to everything they happen to touch. They build up in long streamers on every projection, and the thermo-couple in the flue will be found covered with a mass of several times its own weight. The roof and walls of the gas duct will be carrying a heavy coating of this same material, which usually falls of its own weight after reaching a certain thickness. Under some conditions, however, and especially in places where there is an eddy in the gas stream, these accretions may build up until the duct is practically closed, and heroic measures are necessary to remove the obstruction.

The formation of these half-sintered masses can not be prevented when the kilns are forced as above outlined. Their removal can be greatly facilitated by providing plenty of clean-out doors on the side of each flue. They should not be less than 12 in. square. and there should be one on each side of each hopper if the bottom of the flue consists of a series of hoppers. Poke holes should also be provided in the roof of the flue. If the design is properly carried out in this respect, it should be possible to remove any obstruction to the flow of gas without shutting down.

Suction Fan

It seems to be an unfortunate fact that the fan manufacturers have not so far produced a machine that is really adapted to waste heat boiler practice in cement mills. They are good machines, perhaps, for forced or induced draft for direct fired boilers, though they probably would not be as efficient as other designs. They might make good planing mill exhausters, but they do not stand the punishment they get in cement mill service.

The dust carried in the gas stream is in very large quantities, and of a peculiarly abrasive quality. There are many quite coarse particles that seem to have been practically clinkered. Due to their momentum, they travel on the outside of the curve when the gas flow changes direction. In a single inlet fan, they find their way to the side of the wheel nearest the motor, and cut away that side of the blades and the shroud ring. When thrown out by the wheel, they strike the inside of the scroll-sheet in a narrow strip which they soon cut through. We then have the rather anomalous condition of these coarse particles being thrown out of these openings at the same time that air is being drawn in through these same holes. In a typical fan, the blades are made of ¼-in. steel plate, and the scroll sheet of No. 10. Acetylene welders become quite expert in applying patches to the scroll sheet without stopping the fan, but repairs to the wheel mean a shut-down. In order that the work be done in quick time, the wheel should be split and the casing should have a removable section, so that the wheel may be taken out without disturbing the shaft.

It naturally occurs to one to use a different material for those parts of the fan that wear out most rapidly. The writer has used rolled manganese steel scroll sheets. This is a rather high-priced material, and the results in service did not justify its use. The suggestion is made that the fan blades be cast in white iron, and thicker at the point of greatest erosion, and that the scroll should be cast in sections of white iron. This would be somewhat expensive and entirely in the nature of an experiment, but if thereby a fan could be kept in uninterrupted operation for six months, the expenditure would be worth while.

Fan Motor

The size of motor needed to handle a certain number of pounds of gas per hour at a certain number of revolutions and through a given boiler and economizer can be quite closely approximated. If draft variation is not to be provided for, the squirrel cage motor is the simplest and best. If provision for decrease of draft is desired, a slip ring motor may be used, and it will permit cutting the speed of the fan down about 50%. This is more than will ordinarily be desired. One of the electrical companies has brought out what they call their brush-shifting polyphase motor. It has a commutator like a direct current machine, and the speed is varied by shifting the brushes. It is said to maintain high efficiency and power factor at partial speeds. It is more expensive than either of the other two machines.

FLUE DESIGN

This is a matter that should be determined by the number of kilns in the plant, and by the policy of the company. There are but two alternatives. The kilns may all discharge their gases into a common flue, from which they pass to the boilers; or a boiler may be assigned to each kiln, making with it a unit that has no gas connection with the other kilns or boilers.

The claim is made for the common flue design that it permits complete freedom of choice as to which kilns and which boilers shall be operated. This is true only in plants having a fair number of kilns, say six or more, and having enough boilers so that one of them is not a large proportion of the total. On the other hand, it does permit the number of boilers to be different from the number of kilns. This is of advantage in a mill having a row of rather small kilns, for in such a plant, a boiler proportioned to care for the heat from one kiln would be rather small, and if the boiler capacity were arranged in fewer but larger units, first cost and upkeep would both be lessened.

Consider a plant having two large kilns, this being representative of a number in operation today. Such a mill would likely be designed with two waste heat boilers, each large enough to efficiently care for the heat from one kiln. Suppose that there is a common flue between the kilns and boilers, and that No. 1 kiln is shut down, but it is desired to keep both boilers in operation at their usual rate of steaming. If No. 2 kiln is already working at full load, no more heat can be obtained from it, and the normal flow of gas will have to be divided between two boilers. This will increase the draft of No. 2 kiln and disturb its working, unless the draft is maintained at its usual value by slowing down the induced draft fans. Neither boiler will then develop its normal capacity. Again, No. 2 boiler and economizer alone, if properly designed and operated, will have been bringing the temperature of the gas from No. 2 kiln down to about 400° F. If a portion of the hot gas is sent to No. 1 boiler, it is unlikely that the second boiler will make enough additional steam to run its own induced draft fan.

On the other hand, suppose that both kilns are in full operation, but that it is necessary to shut down one of the boilers. If both kilns are to maintain normal operation they must have normal draft. This means that the gas from both kilns must be passed through a boiler and fan designed to handle half this quantity. To do this would require an enormous increase in the work of the fan, and if it and its motor were designed for the normal rating of the boiler, they would be entirely incapable of doing the extra work demanded of them, for in such circumstances the load on the fan drive increases very much faster than the weight of gas handled.

The common flue would permit No. 1 boiler to operate with No. 2 kiln, or No. 2 boiler to work with No. 1 kiln, at such times as the mill is running at half capacity. This contingency is so remote as hardly to warrant any additional investment to secure it. The same facts would obtain, but in a lesser degree, in a plant having three kilns and three boilers.

The case is somewhat different if a two-kiln plant is provided with a common flue and three boilers, each large enough to handle the gas from one kiln. In this case, any one of the boilers may be out of service, but ready to put under steam in a few hours, in case it is necessary to shut down one of the others. This is a very flexible arrangement, insuring a practically uninterrupted supply of waste heat steam. The only objection is the added cost, for there is involved not only a 50% increase in the investment in boilers and accessories, but also the entire cost of the cross flue, as well as that of a larger building. In an average case, in which superheaters and economizers form part of the equipment, this added investment will amount to about $75,000. Against this must be assessed fixed charges of not less than 15%, plus repair material and labor on the extra equipment.

The necessity for the third boiler will be lessened by everything that is done to insure continuous boiler operation. Of these the first is the use of soft water. With proper design, the fan can be repaired in a few hours. The baffles take longest to repair, because the setting must be cooled down, and hence every precaution should be taken to insure that the baffles are well made.

The mill will have at least one direct fired boiler for use when the kilns are down. If this compares in size with the waste heat boilers, it is possible to force it when one of the latter is out of service, and so get the needed steam without the extra waste heat boiler. Additional fuel will be burned, but only for short periods; and against this fuel cost must be put the initial investment and carrying charges on the extra waste heat boilers. This is a point well worth considering when planning a new installation.

Not so much has so far been said about the influence of waste heat boilers on kiln capacity. It seems to be a fact that in many mills kiln output has been increased by as much as 10% due to the ability to burn more coal in the kiln. If this can be done without great increase in fuel consumption per bbl., it appears to be the wise thing to do, as the output of the whole plant will probably be increased, with a proportionate drop in operating cost per bbl.

The waste heat boiler is probably here to stay until the rotary kiln is replaced by some other manufacturing process, and the writer has endeavored in the foregoing to suggest lines along which boiler practice in this department may be further improved from a position that is already quite satisfacotory.

Materials for Rock Dusting Coal Mines

A survey of the sources of limestone, gypsum, and anhydrite contiguous to coal mining districts has been completed by mineral technologists of the Interior Department on the staff of the Bureau of Mines. This survey was undertaken at the request of coal mine operators, in order that they may know where to obtain suitable materials for rock dusting coal mines to prevent explosions from coal dust. This survey is part of the vigorous campaign being carried on by the Bureau to encourage the use of rock dust in all coal mines having an explosion hazard. Excellent progress is being made in this campaign; coal mine operators all over the country are manifesting great interest and taking steps to rock-dust their mines. A report, which furnishes complete information on the available deposits of limestone, gypsum, and anhydrite, the location o quarries, and facilities for shipment, will be published as a bulletin of the Bureau of Mines.

J. E. Zahn, general manager of the United States Portland Cement Co., Denver, Col., has been named a member of the Industrial Development Committee of the Denver Chamber of Commerce. This is one of the most important committees appointed, one of its purposes being to help new comers and old timers with business suggestions.

New Titan Cement Patented by Eckel

Certain new and useful improvements in processes of making cement and by-products, especially that type of cements having quick hardening and chemically resistant properties, have been invented by Edwin C. Eckel, Washington, D. C., and are covered in a patent, granted October 14, 1924. The following excerpts from the patent specification describe the materials from which the new product is made and the fundamental principles of manufacture.

The object of the invention is to provide a process for the advantageous production of such cements, in connection with metallic iron as a by-product, or vice versa, in the production of metallic iron and slag technically valuable as a cement compound. The present process has advantages resulting from the comparative cheapness of its constituents, as well as a freedom from excessive amounts of silica, which is detrimental to alumina cements.

The process embodies the use of titaniferous iron ore as a constituent. It is well known that in various parts of the world extensive deposits of iron ore exist, too high in titanic oxide to be economically treated under known metallurgical practice. Such ores carry from 10 to 40% of titanic oxide, and are at present useless, since the fuel consumption required in their smelting is too high per ton of metallic iron produced. These titanic ores are characteristically low in sulfur and phosphorus, so that there is a direct incentive to their utilization, provided a profitable method can be provided. The present invention embodies such a method, resulting in the production of a cement slag of the type referred to, as well as in metallic iron of great purity.

The process employed consists typically in charging a mixture of limestone and titaniferous iron ore into a furnace, preferably one equipped with a hot blast, but optionally an electric or other type. The mixture is preferably in such proportions of limestone and the ore, depending on the composition of the latter, as to yield a fusible slag carrying 25 to 50% lime. The temperature is then raised in a blast furnace by using coke, oil, or gas as fuel—at from 1400° to 1500° C., fusion of the charge takes place. The iron oxide in excess of what is needed in the cement is reduced and separates out as metallic iron in the lower part of the furnace, from which it is tapped as in ordinary blast furnace practice. The other constituents—all of the lime and titanic oxide, any alumina that may be present, and between 2 and 10% of the iron oxide—form a fusible slag. This slag is withdrawn, either continuously or intermittently; it is then cooled; and it is then ground to a fine powder—which is the new titan cement claimed in this application.

There are certain details which may be noted here, for the sake of making the description so clear and definite that it may be readily followed and put into practice. For example, the titanic ore-limestone mixture does not normally require briquetting or special treatment, as is necessarily the case with a bauxite-limestone mixture used in the alumina cement manufacture. In running a normal blast furnace, the raw materials are preferentially mixed together and the coke fed in separate layers. The whole operation, in a blast furnace, is essentially continuous. The coke consumption with a good furnace, ranges around 25% of the charge as a maximum; it can be greatly reduced by careful attention to the blast and to tapping.

The metallic iron which separates in the furnace is always low sulfur and normally strict low-phosphorus; lt has a value per ton far greater than the cement. With ordinary mixes, however, there will be produced from 1½ to 3 times as much cement-slag as metallic iron.

A small portion of the reduced metallic iron is apt to be caught in the form of globules in the slag. This is particularly the case in a cool furnace, or when the mix is badly adjusted so as to give insufficient fluidity to the slag. In any case, this trapped portion rarely amounts to over 3 to 5% of the total iron; it is often convenient, thought not strictly necessary, to separate it magnetically from the slag after preliminary grinding, but before sending the cement slag to fine grinders. This is done merely to save wear on the grinding machinery, and not because the presence of the reduced iron globules would have any bad effect on the quality of the cement.

The cooling of the slag exerts a very pronounced influence on its technical properties. With ordinary mixtures, either rapid granulation or extremely slow air-cooling seem to lower the strength and affect the setting time sharply. The preferable method, with an ordinary mixture, seems to be cooling by sprinkling as the slag issue from the tap.

Technically, the titan cements possess valuable properties. If the lime be kept below 50%, and with most mixes preferably about 30 to 40%, the cement hardens, after a normal set, with extreme rapidity and attains very high strengths in 24 to 48 hours. The gain in strength at later periods is at a lower rate, but the strength is at all periods far above that of portland cements. An interesting point of difference between the titan and prior alumina cements lies in their specific gravity and density; a normally burned titan cement will give a gravity of 3.35 to 3.55, with resultant advantages in securing density of the concrete in which it will be used. The resistance to chemical attack is also higher than that of either portland or alumina cements.

The strength of titan cements may be varied at will, through control of the lime-acid ratio; their setting time seems to be determined by method of cooling and by percentage of iron oxide retained in combined form. The product consists essentially of calcium titanate (TiO_2CaO), with subordinate amounts of ferrites, aluminates, and silicate of lime.

In all the preceding description, the term lime is expressly understood to include whatever lesser amount of magnesia may be present (through use of a magnesian limestone or an ore with magnesian gangue). In like manner, the term titanic oxide is understood to include whatever lesser amount of alumina may be present. As a matter of fact, both magnesia and alumina will commonly be kept low in normal commercial practice. High magnesia is apt to give a sticky, non-fluid slag; and alumina, except as brought in incidentally by the iron ores used, would not be an economic addition.

The following is claimed:

1. A cement made from a mixture of titaniferous iron ore and a calcareous material.
2. A cement made from a mixture containing titanium, iron, and calcareous material.
3. A cement material containing calcareous material, titanic oxide, iron oxide, and alumina.
4. The process of making cement comprising fusing a mixture of lime or limestone and titaniferous iron ore and grinding the resulting slag.
5. The process of making cement, comprising fusing a mixture of limestone and titaniferous iron ore, cooling the resulting slag by slight sprinkling and grinding the same.
6. The process of making cement and iron, comprising fusing a mixture of lime and titaniferous iron ore in a furnace, tapping off the resulting iron, and cooling and grinding the remaining cement slag.
7. The process of making cement and iron, comprising fusing a mixture of titaniferous material and calcareous material in a furnace, separating the resulting metallic iron and slag, and cooling and grinding the slag.
8. A cement containing between 25 and 45% of lime, less than 20% of silica and iron oxide together, and from 10 to 60% of titanic oxide.

Plastic Refractories

An investigation has been started by the Bureau of Standards to determine the physical and chemical characteristics of the so-called plastic refractories which are used in making rammed-in linings for furnaces. These refractories are used principally around the burner parts and in other places requiring special refractory shapes. Eleven 100-lb. samples have been obtained through the cooperation of the Philadelphia Navy Yard, and during the past month, the determination of dried strength, drying shrinkage, and the screen analyses have been completed on all of the samples. The data obtained will be used as a basis for specifications.

The modulus of rupture for the dry material has been found to vary approximately from 30 to 110 lb. per sq. in., while the drying shrinkage, which is an important property for this type of material, does not exceed 2%. In addition, regular 9-in. and 10 x 3 x 3-in. shapes have been prepared and are being burned preparatory to testing in the burnt stage.

Construction of a railroad and the erection of a washing plant near Chuckatuck, Nansemond Co., Va., has been started by the International Portland Cement Corp., of New York. Extensive marl beds near Chuckatuck have been purchased by the cement company, and about 150 men will be employed on the project, according to recent reports. It is estimated that the International Cement Corp. has increased the capacity of its plants by 1,300,000 bbls. so far this year.

Excess Air in Rotary Kilns

By Edwin Hayes Pentland

Numerous articles call attention to the fact that most kilns are operated at lowered efficiency due to the excess air used. Information which might help in improving the present methods is not given.

The common practice in kiln operation is to adjust the conditions to get a fuel consumption approximating a certain figure. In case the draft is too great, air is admitted at the base of the stack until conditions are found satisfactory. The stack temperature is then noted and used as a guide. This method may or may not give the most efficient operation, depending on how it is applied.

There must be some certain percentage of excess air which will give most efficient operation. If too much air is used, the kiln is cooled and heat is consumed in raising this excess to the stack temperature. If too little air is used, incomplete combustion may result, which will cause quite as serious losses. If the kiln is to be operated at maximum efficiency, the sum of those two losses must be a minimum.

Reasoning from theory, it would seem that, since

$$CO_2 = CO + \tfrac{1}{2}O_2$$

and (%CO_2 by volume) times a constant equals

(%CO by volume) times (%O_2 by volume),

it might be necessary to add an unusual amount of air to keep down the carbon monoxide, because the carbon dioxide is higher than in common furnaces. That the theory does not account for the facts can easily be seen after making a few computations.

Using the best data obtainable,[1] we find that at 2600° F. CO_2 dissociates 0.025%, and at 2800° F. is 0.064% dissociated. Using 0.04 as a fair average and solving for the constant:

100 CO_2 gives 0.04 CO and 0.04 ($\tfrac{1}{2}O_2$)

$$\text{or } K = \frac{0.04\sqrt{0.04}}{99.96} = \frac{0.008}{99.96} = 8.0.10^{-6} = 0.000{,}000{,}8$$

Suppose the CO_2 to be 12.0% and the O_2 to be 11.0%; solving for CO:

$$CO = (12/11)\ 0.000{,}000{,}8 = \text{an imperceptible } \%.$$

Percentages of carbon monoxide which are commonly observed cannot be accounted for on the basis of equilibrium. This does not mean that the theoretical data are incorrect, but indicates that the carbon monoxide is due to other causes.

Carbon monoxide may be formed in either of two ways: Carbon or organic matter will reduce CO_2. In some cases, this may possibly occur. Carbon monoxide may also be due to the fact that the burning gases are drawn away and chilled before combustion is completed. The carbon monoxide will depend on the design and upon how it is operated.

In order to get the proper amount of air to combine with the fuel, we could do either of two things. The fuel consumption and the speed of the kiln can be increased, or leaving the fuel the same, the draft may be gradually decreased by letting in air at the base of the stack until the gases from the kiln are of the best composition. Increasing the speed of the kiln decreases the time of burning. Cutting down the draft is to be preferred.

To compare two kiln gas analyses, it is only necessary to find the relative amounts of heat lost in several cases. The following formula gives a correct comparative figure.[2]

$$\text{Loss from CO} = \%CO\ (46480 + 3.78 \times t.)$$

$$\text{Loss from air} = \%O_2 \times 22.3 \times t.$$

(t = difference between stack temperature and temperature of air entering kiln.)

To find the actual heat lost, it is necessary to convert the gas analysis from per cent by volume to per cent by weight. This is most easily done by multiplying the percentage of each gas by its molecular weight and dividing the figures so obtained by their totals, when only CO_2, CO and O_2 are determined. The undetermined can be taken as nitrogen without great error, provided the water has been condensed for analyzing. To find the weight of flue gases, divide the percent CO_2 by weight, into the weight CO_2 formed as calculated from the weights and analysis of the raw mix and fuel, and add the water formed.

After the correct operating conditions are found, the stack temperature can be used as a guide, checking occasionally by analysis.

Development of Trade Associations Analyzed

The Government's policy towards cooperation and combination in private business enterprise, as expressed in the anti-trust laws, judicial practice, and the activities of the Federal Trade Commission, present difficulties of the greatest importance to the business public, the National Industrial Conference Board comments, in announcing that it will make public soon a report analyzing the development of trade associations, the legal status and economic importance of their activities.

A lack of clear and definite expression of public policy towards new forms of business activities, which have grown up out of changing economic conditions, jeopardizes business, and since the whole issue of such policy has been raised in connection with the effort of the Secretary of Commerce and the Attorney General to define what trade associations may or may not do, the board's report will embrace a comprehensive survey and analysis of trade associations and their activities.

The Board has been engaged for more than a year in a study of the development and present status of the Government's attitude towards private business, with special reference to the application of the anti-trust laws. This study has covered the legal and economic aspects of the development and regulation of industrial combinations and the control of various forms of business cooperation and trade practices, and the financial and economic aspects of business combinations.

The purpose of the Board's investigation is to clarify for the public and the business community the present situation with respect to governmental policy, so as to provide a sounder and more scientific basis for discussion of the vital issues which have arisen. The investigation has been carried out by the research staff of the Board in cooperation with a group of recognized legal and economic authorities and a large body of industrial and business leaders.

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[1] Lewis & Randall, *Thermodynamics*.

[2] Since equal volumes of gases at the same temperature and pressure contain the same number of molecules, the weights of equal volumes are to each other as their molecular weights. Molecular weight $CO = 28$, oxygen (O_2) $= 32$, therefore the ratio of the weights of one per cent of CO and O, are as 28 to 32. Since the oxygen comes in air associated with 79% nitrogen ($N_2 = 28$) by volume, we must add $(1 \div 0.79)$ 28 to the oxygen to determine the excess air. The ratio of the weights of CO and excess air are thus known and can be used for comparative computations.

Silica Cement Made in France

There is a high silica cement manufactured in France, by the Lafarge Co., through the quick lime process. This cement contains about 23% or 24% of silica, a little less than 2% of alumina, and 67% to 68% of CaO. The complete analysis of this cement is as follows:

Silica	23.66
Alumina and iron peroxide	3.07
CaO	67.83
Magnesia	1.86
Sulfuric acid	0.68
Volatile matters and water	1.43
Carbonic acid	1.24
Losses	0.23
Total	100.00

The setting is rather slow, due to the fact that the ratio between silica and alumina is 3 to 4 times higher than in ordinary artificial portland cement. The setting begins after 3 hours, and is completed in 11 hours.

This slow setting of high silica cement is an advantage for works to be executed in hot climates, or in hot summer times.

The silica cements are very resistant to the dry air of tropical climates.

It is also claimed that due to the low percentage of alumina, these cements do not lose their quality when stored for quite a long time. Another superiority of the high silica cements over the high alumina cements in works executed in sea water is their resistance to decomposition. It is known that in some high alumina cements, lime and alumina might combine with the sulfates contained in sea water, and this action will quickly disintegrate the masonry work. This applies particularly to the alumina cements as manufactured in vertical or rotary kilns. It should be mentioned, however, that high alumina cements manufactured in water jacket or electric furnaces, and called "molten cement," is unalterable in this respect, due to the high ratio between alumina and lime.

The resistances as indicated by tests made on pure cement are as follows:

Residue on screen having 4900 apertures per sq. cm. —less than 5%

Breaking strength after	2 days	7 days	1 month	3 months	6 months	1 year
Tension	241 lb.	511 lb.	640 lb.	640 lb.	667 lb.	680 lb.
Compression	2,990 lb.	7,300 lb.	10,900 lb.	11,000 lb.	11,160 lb.	12,500 lb.

Portland Cement for September

Shipments of portland cement in September maintained their high level, while production decreased but was at a higher rate than in any month except August. Stocks are over 51% higher than in September, 1923.

The production, as reported by the United States Geological Survey, based mainly upon reports of producers of portland cement but in part on estimates, was 14,519,000 bbls. Shipments amounted to 16,827,000 bbls., and stocks, at the end of September, totaled 8,358,000 bbls. Stocks of clinker or unground cement at mills at end of September, 1924, amounted to 4,275,000 bbls., compared with 5,367,000 bbls. at the beginning of the month.

The Bureau of Foreign and Domestic Commerce of the Department of Commerce reports that the imports of hydraulic cements in August, 1924, amounted to 192,634 bbls., valued at $305,690. The total imports in 1923 amounted to 1,678,636 bbls., valued at $2,964,098.

The exports of hydraulic cement in August, 1924, were 85,883 bbls., valued at $251,904, of which there was sent to South America 32,964 bbls.; to Cuba, 25,444 bbls.; to the other West Indies, 5106 bbls.; Central America, 13,136 bbls.; Mexico, 7102 bbls.; Canada, 982 bbls.; and to other countries, 1149 bbls. These exports are exclusive of shipments to the following possessions: Alaska, 1679 bbls.; Hawaii, 1455 bbls.; Porto Rico, 7834 bbls.

The statistics of imports and exports of hydraulic cement in September, 1924, are not available.

No Dumping of Portland Cement Found

No dumping of portland cement on the American market by European countries has been found by the Customs Division of the Treasury Department, E. W. Camp, director of customs, announced October 1. Neither the evidence adduced nor the official reports of the customs investigating officers establish with any certainty that, as a general practice, and taking into consideration the very great differences in wholesale quantities, cement has been sold to the United States at less than the foreign home market value.

The evidence of injury submitted by the domestic manufacturers, Mr. Camp said, is very general, and in no case is any specific loss or injury directly traced to sales to their customers of European cement at less than the foreign home market value. The situation presents, however, a number of doubtful questions of appraisement, according to Mr. Camp.

Imports during 1923 from the countries accused of dumping were only 1.04% of the total domestic production of the United States.

"Even admitting the claim of the domestic manufacturers that the sea-coast districts where the imported cement is distributed, should be considered as units independently of the interior of the country, the official statistics," Mr. Camp advised, "and the trade papers indicate wonderful prosperity of the cement industry in those districts in 1923 and 1924, with imports insignificant as compared with the domestic production and sales."

Mr. Camp has addressed a memorandum to McKenzie Moss, Assistant Secretary of the Treasury in charge of customs, recommending that no finding of dumping be issued.

Anhydrite Studies

Experimental work on the use of anhydrite as a cement retarder has been undertaken by the Interior Department. Requests for 25-lb. samples of cement clinker have been sent to about 20 cement plants in various parts of the country by the New Brunswick, N. J., experiment station of the Bureau of Mines, where the experimental work is being conducted. It is considered that a method of rehydrating anhydrite profitably would be of great advantage in brass foundry practice, as the hot metal dehydrates plaster of Paris molds, making them useless for further employment.

Modern Quality Standards of Portland Cement in England

Abstracted from *Concrete and Constructional Engineering*.

It is doubtful whether the degree of precision reached during the past few years in the production of portland cement has been realized outside the narrow circle of cement manufacturers. Although it must be admitted that the manufacture still has an empirical basis, and there is still some doubt as to the exact chemical compounds present in cement, yet the conditions required to produce a good quality cement are so exactly known that it has become merely a matter of possessing the necessary appliances for a manufacturer to be able to reach and maintain a high standard of quality.

So far as freedom from impurity is concerned, the only item in a chemical analysis of portland cement that can be classed as impurity is insoluble matter, and in the product of a modern factory this is less than ½%. A purity exceeding 99½% is a standard hardly to be improved upon, and one comparing favorably with the products of other industries.

Chemical purity alone, however, does not determine the quality of cement, and another important feature is regularity of composition. The preparation of the mixture of raw materials (by the wet method) has been improved to such an extent that the proportion of carbonate of lime in the slurry does not vary by more than 0.2% during a day. When dealing with raw materials dug from the earth's crust at the rate of a few hundred tons per day this may seem a wonderful achievement, but there is no wizardry about it. The huge mixing basins that are prominent in cement factories usually contain enough mixed raw material to last for several days' manufacture, thus giving the chemists the same period of time for adjusting the mixture to the required composition before it is passed on to the next stage. Time and common sense are all that are required to produce the regularity referred to.

The next stage in the manufacture is the burning or calcination, and so long as the material is heated to a given temperature for a given time, the result will be satisfactory. With a continuous kiln, such as a rotary kiln, all that is necessary to produce this result is to feed a constant quantity of raw material mixture (slurry) into the kiln at one end, and at the other end to supply heat in the form of a constant stream of coal (ground to a constant fineness) with the necessary volume of hot air for combustion. Instruments for recording temperatures, volumes of air passing, composition of combustion gases, etc., are provided, so that any change in conditions can be immediately detected and adjusted. The result is seen in a constant stream of well-burnt clinker issuing from the kiln, and runs of a week or more without a minute's stoppage are achieved.

The final stage in the manufacture is clinker grinding, and with modern grinding plant this is performed by passing the requisite quantity of clinker per hour into a mill. The issue of a constant stream of cement of consistent fineness is then practically assured. The fineness is, however, checked by frequent sieve tests.

There is thus no reason why cement made with modern appliances should vary in quality, and, as stated at the outset of this note, the degree of consistency of quality in a portland cement factory of today is remarkable. From a chemical standpoint, cement manufacture is simple, comprising no more than the grinding and mixing of two materials, heating the mixture to a given temperature, and grinding the product. Needless to add, perfection of mixing, burning, and grinding is only attained by the use of extensive plant, involving a large consumption of power and heavy charges for renewals which inevitably tend to increase the cost of production in an almost direct ratio with each improvement in quality.

Economy in Cement Manufacture

Some information upon the work being done by the British Portland Cement Research Association is given in a pamphlet entitled "The Viscosity of Raw Material Slurry Used in the Manufacture of Portland Cement," recently issued by the Association. The pamphlet deals with methods of reducing the proportion of water in slurry as known by cement manufacturers.

In considering the relative advantages of the wet and dry processes of cement manufacture, the most serious objection to the wet process is the expenditure of fuel that is necessary in the kiln to dry out the 40% or so of water that is present in the slurry. At least 7 tons of fuel per 100 tons of cement are consumed in this way, and, although in the majority of cases this expense is counterbalanced by the advantages of the wet process over the dry process, it is regarded by manufacturers as one of the hindrances to the cheap production of cement. Hence, in investigating the possibility of reducing the proportion of water in slurry, the British Portland Cement Research Association is performing a distinct service to the industry and indirectly to the cement consumer.

The fact that minute additions of sodium carbonate (washing soda or soda ash) or other salts to clay slurries render the latter more fluid has been known in the pottery trade for many years, but the possibility of utilizing the phenomenon in the cement industry does not appear to have been recognized until 1916. Several manufacturers then experimented, and found, that by adding a few pounds of soda per ton of raw material, they were able in some cases to produce a slurry of the usual consistency with from 2 to 6% less water. With this reduced proportion of water it was possible to reduce the fuel consumption in the rotary kiln. The commercial advantage of the soda addition depends upon the actual reduction in the proportion of water in the slurry and the price of coal; the Research Association pamphlet shows that when 0.075% of soda ash, costing £10 per ton, is added to slurry and the proportion of water is reduced by 4%, there would be a saving of 15*s.* 10*d.* per 100 tons of clinker if ground coal cost 30*s.* per ton.

The varying effects of the addition of soda to different slurries were investigated, and one of the causes was found to be the soluble salts contained in the raw materials or in the water of the slurry, which reacted chemically with the soda and destroyed its action. There are other causes operating which are at present obscure.

With the information provided by the Research Association before them, cement manufacturers are able to determine very readily for themselves what advantage can be gained in each particular case from adding soda to slurry.

The Northern Blower Co. Cleveland, Ohio, has just closed a contract with the Indiana Portland Cement Co. for installing dust collectors in its finishing and bagging departments. It is expected the work will be completed by January 1.

How Cement Hardens

An explanation of the setting and hardening of portland cement, which differs considerably from those generally accepted, and indeed seems to disprove them, has recently been published by F. Tippmann, who disagrees with Kühl's theory that gypsum reduces the speed of setting by forming a calcium sulfo-aluminate with the tricalcium aluminate in the cement. He points out that the occurrence of this sulfo-aluminate in ordinary cement has never been proved, and that his own investigations suggest the production of colloidal matter simultaneously with crystals. He considers that the setting is not due to a saturated solution of lime, but to the dissociated sulfate-ion of calcium sulfate, as cements which are quite free from sulfates behave quite differently from ordinary portland cement and do not swell in water, even after a year; yet when mixed with a small proportion of gypsum, they swell to 200-300 times their original volume in 2 minutes. The addition of lime-water to sulfur-free cements has no effect, but free sulfuric acid acts like gypsum. In the absence of sulfate-ions, no colloidal gel is formed, but when the cement contains only 0.3% of gypsum, abundant colloidal matter is produced by immersing the clinker in water. Gypsum was also found to inhibit the formation of crystals of calcium hydroxide. The author attributes the expansion and cracking of some cement-pats to an excess of gypsum, which decomposes the colloidal gel liberated by a very small proportion of gypsum. The effect of an increasing content of gypsum on the setting and hardening times of a cement is very striking, as the setting time remains almost constant, but the time of hardening increases with the proportion of gypsum, i. e., with the proportion of colloidal matter, up to a limit beyond which the gypsum begins to have a destructive action. In short, a little gypsum in cement restricts crystallization and facilitates the formation of a colloidal gel. In other words, it is shown that a quick-setting cement owes this property to crystallization from a supersaturated solution; a slow-setting cement to the much slower coagulation of a supersaturated highly dispersed colloidal sol.—*Zement.*

German Observations on Cement

Dr. Otto Schott has recently published a series of observations on cement, based on experiments which have, in some cases, lasted as long as six years.

He found, for instance, that if a thin pat of neat cement is suspended in a shallow air-tight vessel of water, crystals of calcium hydrate gradually form, and in six years are clearly visible to the naked eye. This experiment clearly proves that water can decompose portland cement, forming simple compounds and calcium hydrate, and from it Dr. Schott concludes that the hardening of cement is chiefly due to the adhesion of the particles of silicate, the spaces between them being filled with the crystalline hydrate. He considers that this explains why cements rich in lime and those which are exceptionally finely ground harden more rapidly than others. He regards expansion and the resulting cracking as due to the formation of an excess of the calcium hydrate crystals from a cement unduly high in lime.

In addition to the crystals just mentioned, Dr. Schott observed a gelatinous growth of mono-calcium silicate. A series of 168 cements was made from pure silica, pure alumina, pure iron oxide, and pure lime, the mixtures being burned in an electric furnace at a temperature high enough to effect sintering. The temperature varied with the composition of the mixture; in some instances it reached 2000° C. with cements rich in iron oxide or alumina. Iron oxide behaved curiously, as it increased the sintering temperature of mixtures rich in that oxide, but in smaller proportions it acted as a flux.

A micro-petrographic examination of the cements showed the following: The aluminous cements contained small crystals of calcium aluminate ($3CaOAl_2O_3$). A cement composed wholly of this substance is only feebly doubly refractive, but one composed of tricalcium ferrite ($3CaOFe_2O_3$) is strongly doubly refractive, though much less transparent. Some of the clinkers contained definite crystals with double refraction and a composition corresponding to Janecke's compound ($8CaO$, $2\ SiO_2$, Al_2O_3), while the corresponding iron compounds produced beautiful crystals with strong double refraction.

The cements rich in alumina were very difficult to work, and even when mixed with 2% of gypsum required about an hour to set. The corresponding iron cements set in 10 to 20 minutes.

Compression tests showed that the strength is roughly proportional to the lime-content until the tri-calcium compounds are formed. An excess of lime then causes cracking, and consequent weakness. The iron oxide cements set very slowly, and are weaker than the alumina cements, yet reached 5600 lb. per sq. in. in 28 days. The hardness was greatess with aluminous cements, but an excess of alumina it harmful, as it causes cracks.—*Tonindustrie Zeitung.*

H. K. G. Bamber Killed

H. K. G. Bamber, for many years a director of the Associated Portland Cement Manufacturers, Ltd., was killed recently in a motor car accident on the Meopham Road, near Gravesend, England. As the result of a collision, his car overturned and was badly smashed. Mr. Bamber died almost immediately, and his brother, who was with him, also received serious injuries. His son escaped injury.

The Bamber method of regulating the setting time of portland cement is well known. It consists of passing steam under a suitable pressure into the tube mill, through the hollow trunnion at the feed end while the cement is being ground. The setting time of the finished cement then depended upon the pressure of the steam admitted. It was considered that the steam affected some of the less stable aluminates, as well as slaked any free lime which might be present.

Mechanical Engineers to Meet

The American Society of Mechanical Engineers will hold its 45th annual meeting December 1-4, 1924 in New York City.

The third annual exposition of Power and Mechnical Engineering will start on the same day the annual meeting of the Society begins. A floor space of 150,000 sq. ft. in the Grand Central Palace will be occupied by exhibits of nearly 300 manufacturers. Types of apparatus to be displayed include: steam boilers, superheaters and economizers, air pre-heaters, stokers, prime movers, ash and coal handling equipment, heating and ventilating equipment and refrigerating machinery.

Men and Mills

Notes from the Field

Principal units of the Kansas Portland Cement Co.'s new plant at Bonner Springs, Kans., have been completed, and the organization, employing 250 men, is prepared to produce cement at the rate of 3000 bbls. a day. The investment in the new building and equipment, it is estimated, is more than a million and a quarter dollars.

The plant buildings have concrete foundations and steel frames. One large structure houses the rock crushers. The material trains are run directly into this building, releasing their loads into hoppers. Three hundred 5-ton cars of rock can be crushed daily in this building.

Adjoining the grinding building is the 4-story structure housing the three kilns, each 220 ft. long and 9 ft. in diameter. Other principal buildings are: the stock house, a tall structure of monolithic concrete where 120,000 bbls. of cement can be stored; a packing building where 30,000 sacks of cement can be filled daily and loaded; and a power plant housing transformers and motors.

The buildings are just east of Bonner Springs on the Union Pacific highway. Executive offices are located in the Federal Reserve Bank Building. J. A. Lehaney is general manager.

F. L. Williamson, formerly vice president and sales manager for the Dewey Cement Co., has severed his connection with that concern.

O. F. Swanson has severed his connection with the Great Western Portland Cement Co., for which he was formerly general manager.

With representatives of the Santa Fe, Union Pacific, Burlington and the Denver & Rio Grande railroads objecting, protesting, and interjecting, Henry C. Hall, chairman of the Interstate Commerce Commission, spent two days at Estes Park, Col., during middle September, hearing the petition of the Colorado Portland Cement Producers Association seeking lower rates on freight shipments from Middle Western cement mills.

During the hearing, the Denver & Rio Grande advanced a proposal for reduced rates that would cover shipments only from mills located in the Oklahoma and Kansas gas belts. The Union Pacific proposed, if the commission found that the rates were too high and a cut was ordered, that the shippers be compensated.

Following the adjournment of the hearing on the cement business, Chairman Hall heard pleas for lower freight rates on coal.

W. R. Phillips, formerly general manager of the American Lime & Stone Co., Bellefonte, Pa., has resigned to become vice president and general manager of the New England Portland Cement & Lime Co.

Samuel M. Shallcross has been appointed general manager of the American Lime & Stone Co. to fill the place made vacant by the resignation of Mr. Phillips. Mr. Shallcross was treasurer of the American company up to the time of his appointment by the board of directors, and was also acting general manager.

The initial dividend of 5% on the common stock of the Oregon Portland Cement Co., Oswego, Ore., was paid recently. Dividends of the 7% preferred have been paid to July 31, and another semi-annual distribution of 3½% will be payable January 31, according to an announcement credited to L. C. Newlands, vice president and general manager of the company.

Representative members of the Association of General Contractors of North Carolina, 116 in number, recently visited the plant of the Phoenix Portland Cement Co., at Birmingham, Ala., as the guests of the cement company. The contractors arrived at Birmingham on a special train, and were met at the station by Lindley C. Morton, president of the cement company, and others. These contractors visited Birmingham at the invitation of the Phoenix Portland Cement Co., and were shown over the cement mills and other manufacturing plants of the Birmingham district.

The Penn Allen Cement Co. is erecting, at a large cost, seven large silos in which cement will be stored prior to packing, according to word from that locality.

The National Cement Co., Montreal East, Quebec, is completing the construction of its new plant, according to advices from Canada.

The sixteenth plant of the Lehigh Portland Cement Co., located at Boyles, a suburb of Birmingham, Ala., was formally opened for inspection on September 25, when officials of the company were hosts at a barbecue served on the lawn at the plant. More than 200 of the district engineers, architects, builders, officials, and others inspected the plant and manufacturing process.

District Sales Manager Traynor extended the hospitality of the company to those accepting the invitation. Other officials, including R. H. MacFetridge, superintendent, escorted visitors through the plant and explained the process of cement making.

The acquisition of additional plants by the Link-Belt Co. and the considerable extension of its lines and business during the past five years, have prompted Charles Piez, president of the company, to suggest to the Board of Directors some changes in the organization, which, through a partial decentralization of functions, will reduce the burdens on the present officers and open the way for a continuation of the policy of expansion. Mr. Piez was elected chairman of the executive committee. Alfred Kauffman, newly elected president; Staunton B. Peck, senior vice president; and Thomas B. Marston, a member of the board of directors, were selected as the other three members of the executive committee.

The Pawling and Harnischafeger Co., of Milwaukee, Wis., is celebrating its 40th year of progress in the manufacture and sale of crane and excavating machinery. It has recently added a large steel foundry to the great amount of equipment which is used in the production of this heavy machinery.

This foundry was formerly operated by the Hercules Steel Casting Co. for commercial production, but is now entirely devoted to the steel castings required for the production of P&H machines.

International Cement Corp. declared regular quarterly dividends of $1 on common and $1.75 on preferred, both payable September 30 to stock of record September 15.

Sixteen very attractive loving cups have been awarded to the plants of the Lehigh Portland Cement Co. at the close of the fourth annual June safety campaign. More than ordinary results were obtained, as the campaign was conducted without any lost time accidents. During June, the plants that were awarded the cups went through the campaign with only minor accidents, which did not require men to leave their work.

The Texas Portland Cement Co. has filed complaint with the Interstate Commerce Commission protesting against the present freight rates on cement out of its mill at Harrys, Texas, and asking the Commission to order establishment of rates for the future to stations in Oklahoma and in Texas, on the Wellington branch of the Missouri-Kansas-Texas, and on the Spearman branch of the Panhandle & Santa Fe that are the same as the rates to the same points from Ada, Okla.

What is believed to have been another attempt to burn the packing house of the Edison Portland Cement plant at New Village, N. J., was discovered by a night watchman, who with an assistant, was able to extinguish the fire. Slight damage was done. It is expected an investigation will be started, as this fire, coming so soon after the disastrous fire at the plant some time ago, makes it appear that there may be an organized plot to fire the plant.

The Phoenix Cement Co., Nazareth, recently gave a clam bake to its office force and employes.

A party of members of the Chicago Association of Commerce recently inspected the Buffington plant of the Universal Portland Cement Co.

L. R. Burch, vice president of the Atlas Portland Cement Co., New York City, sailed for Europe on the steamship America, of the United States lines, on October 22.

John Monaghan, organizer and first president of the old Alpena Portland Cement Co. and known locally as the father of the cement industry in Alpena, died October 17 at his Alpena home after an illness which developed last July.

Mr. Monaghan was born October 31, 1834 in Ireland and came to America in 1856.

After experiments which he made with rock found in the vicinity of Alpena and in which he used first an old coal stove and later a forge at a blacksmith ship, he produced the first portland cement made in Alpena. Steps were taken for the organization of the Alpena Portland Cement Co., of which he was the first president and for which he also served as sales manager and secretary until the year 1907.

Among the seven children surviving Mr. Monaghan is Frank P. Monaghan, Glens Falls, N. Y., superintendent of the Glens Falls Portland Cement Co.

Among industrial common stocks which carry the promise of an increase dividend in 1925 may be mentioned the International Cement Corp. according to the *Wall Street Journal*. The international Cement Corp. earned $6.37 a share on its common stock in 1923. Inasmuch as the Kansas plant went into operation in July, 1924, the second half-year profits in 1924 should be sufficient to bring the full year's net up to approximately $7 a share. The company's capitalization consists of $3,432,700 7% cumulative preferred, par $100, and 364,167 shares of common without par. There are no bonds. Dividends on the common were inaugurated at the annual rate of $2.50 per share in September, 1920; these have been increased until $4 per share was paid in December 1923.

State Budget Director, of Michigan, Henry Croll, Jr. is credited with the statement in a newspaper account that the state operated cement plant at Chelsea had netted a profit on October 1, of $79,502.68 and in addition had paid $65,000 of the $75,000 rental for the year. His estimate of the profit for the year is given as $120,000.

The plant was taken over by the state under an optional agreement to purchase with the annual rental to be applied on the purchase price. Sales since state operation was started are given as 371,617 bbls. of cement which sold for $680,100. All of the cement was sold for state use.

The plant has been operated by the state using prisoner labor. Prisoners are paid on a daily basis with a bonus based on the weekly production.

Operation of proposed changes in the freight rates on cement from Ada and Hartshorne, Okla., mills to points in northern Texas, which would result generally in increases over present rates, has been suspended by the Interstate Commerce Commission until February 12 next. The schedules were filed to become effective October 15, as published in Supplements Nos. 57, 61, and 62 to Agent F. A. Leland's tariff I. C. C. 1590. The present rate from Ada, Okla., to Arab, Leeray, and Wayland, Texas, is 25¢ per 100 lb. and the proposed rate, 33¢. The existing rate to Jimkurn, Texas, is 34¢ and the proposed rate 33¢.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

Of Cement Mill Edition of CONCRETE, published monthly at Detroit, Michigan for October, 1924.

State of Michigan, } ss.
County of Wayne, }

Before me, a Notary Public, in and for the State and County aforesaid, personally appeared R. Marshall, who, having been duly sworn according to law, deposes and says that he is the General Manager of the Cement Mill Edition of CONCRETE, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 443, Postal Laws and Regulations, printed on the reverse side of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher—Concrete-Cement Age Publ. Co., Detroit, Mich.
President—R. Marshall, Detroit, Mich.
Managing Editor—Harvey Whipple. Detroit, Mich.
General Manager—R. Marshall, Detroit, Mich.

2. That the owners are (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock):

Concrete-Cement Age Pub. Co., 1807 E. Grand Blvd., Detroit, Mich.
R. Marshall, 1807 E. Grand Blvd., Detroit, Mich.
Harvey Whipple, 1807 E. Grand Blvd., Detroit, Mich.
F. F. Lincoln, Room 1710, 115 Broadway, New York City.
R. N. Jackson, 1807 E. Grand Blvd., Detroit, Mich.
R. W. Lesley, Pennsylvania Bldg., Philadelphia, Pa.
Edward B. Bruce, Manila, P. I.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above ,giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholders or security holders appear upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest, direct or indirect, in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers, during the six months preceding the date shown above is———. (This information is required from daily publications only.)

R. MARSHALL,
Manager.

Sworn to and subscribed to before me this 28th day of Sept., 1924.
(Seal.) PERSIS E. HILL.
(My commission expires August 10, 1928.)

New Oil Circuit Breaker

The Westinghouse Electric and Manufacturing Co. has developed a line of indoor service electrically operated oil circuit-breakers, in which are incorporated several new and distinctive features. These breakers are 3 pole, single throw, either non-automatic or automatic in operation, for capacities up to 2,000 amperes and alternating current voltages up to 25,000 with interrupting capacities at the rated voltage of approximately 9,500 and 13,000 amperes respectively. They are particularly adapted to the control of alternating-current circuits of large capacity where the voltage does not exceed 25,000 volts. Each of the two forms, CO-11 and CO-22, has a different maximum interrupting capacity but the details of construction are similar. The manufacturers describe outstanding features:

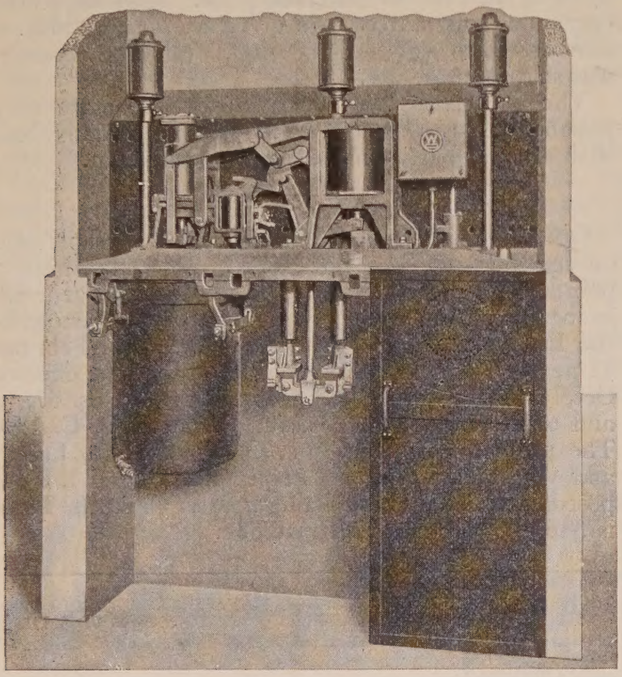


Fig. 1—Oil Circuit Breaker with Doors Removed from Two-Pole Units and Tank Removed from One-Pole-Unit

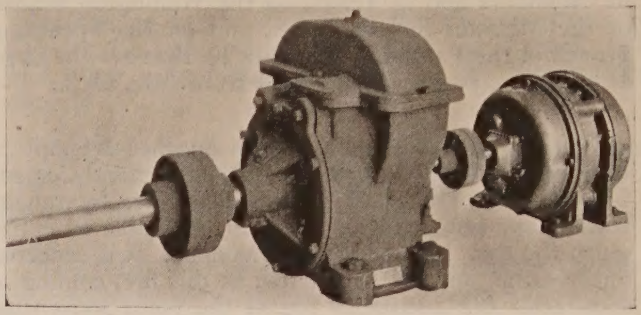
The two outstanding features in the construction of this type of breaker are its compactness and its ease of installation. No intermediate structure walls are required for supporting the individual poles. The breaker is supported by means of anchor-plates set in and projecting from the cell walls. The steel top of the breaker, which rests on these plates, is bolted securely in place. Where space considerations are of prime importance, a saving of almost 6 in. per 3 pole breaker can be made in length of cell structure by the use of steel compartments instead of concrete compartments. The space between the breaker top and the floor, in front of the tanks, is covered with removable doors, each consisting of a metal frame with asbestos panels and hinged at the top to the mechanism base.

These breakers have efficient, self-cleaning parallel path type of high pressure laminated brush main contacts, especially adapted to heavy power systems, due to the fact that contact pressure is increased through the attraction of the current flowing in the same direction in parallel paths. The main contacts are protected by extra heavy arcing contacts, according to the manufacturers.

The CO breaker is operated by a unit type solenoid mechanism mounted above the poles on the top of the steel bed plate forming the cell top. After the breaker is closed by the solenoid, it is held in the closed position by a hardened steel latch with which a trigger engages automatically. The oil circuit breaker is equipped with a special control relay panel which is provided with a two piece contact arm and release coil. As soon as the circuit breaker is closed by the operator in the usual manner, the pallet switch on the breaker energizes the release coil of the control relay. This release coil opens the contact of the control relay, irrespective of the fact that the operator may hold the control switch in the closed position and thus still be energizing the main control coil of the control relay By the use of this special control relay, full automatic protection can be secured where the breaker is used in connection with overload relays and current transformers.

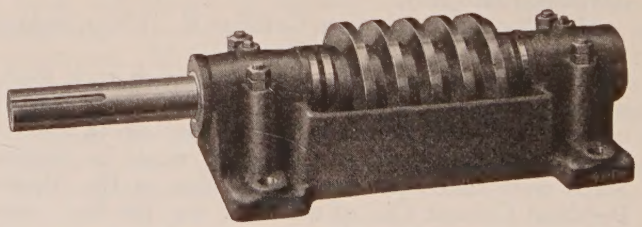
Spur Gear Speed Transformer

The accompanying illustration shows the Industrial Type spur gear speed transformer developed by the Hill Clutch Machine & Foundry Co., Cleveland, Ohio. It is described as an efficient and durable speed-changing device for such service as is encountered in connection with conveyor drives, in pulp and paper mills, mines, smelters, steel plants, refineries, cement mills, brick plants, and, in fact, for all general industrial work where speed transformer units are operated under continuous or heavy service conditions; in other words, something substantial to meet the everyday rough usage of mill operation.

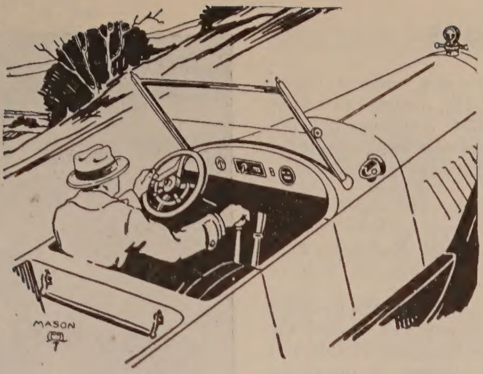


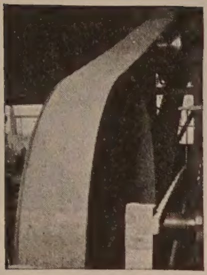
The Industrial Type speed transformer consists of a nest of plain spur gears revolving in oil, changing the revolutions per minute of the input shaft to some desired revolutions per minute of the output shaft. The power transmitted is the same in both shafts. The gears all have 20° involute form cut teeth. The short length of these teeth, combined with their powerful cross section, insures great strength and reliability. This speed transformer is made in seven sizes. Each size has a number which bears a fixed relation to the diameter of the low speed shaft. The number also indicates the horsepower the low speed is capable of safely transmitting at 100 R.P.M.

Double Thrust Worm Box



The Jones double thrust worm box has just been placed on the market by the W. A. Jones Foundry & Machine Co., of Chicago, Ill. It is designed to provide an accurate and rigid support for the worm shaft and holds a liberal supply of oil in which the worm operates. There is also provided finished thrust washers at both ends of the worm, consisting of two steel washers and the center one of hard fiber. The bearings are babbitted and bored and faced on ends. These boxes are now made in standard sizes to suit standard cut steel worms as made by the Jones company, and both the boxes and gears are covered by their new catalog No. 29, *Jones Gears*, which is just off the press.





Here's a Gandy

— installed way back in 1905 and never even taken up in all that time. No wonder Mr. Haar of the Busse Brick Company says it is a "wonderful belt". — We are still putting the same old Gandy quality in every Gandy Belt turned out. They will save money for you on many installations. Write for prices and complete information.

YOU CAN'T CLIMB ALL HILLS IN HIGH ! ! !

—And it's wrong to try to cover too much territory with one or two kinds of Belting. You can't expect even the best rubber or leather belt to give the most efficient service on belting jobs that call for Stitched Cotton Duck Belt. Canvas belt is *not* a substitute. It has been standard for its service since 1880, i. e., where heat, moisture, oil and exposure to weather must be overcome. Use the right belt for the job—tough Gandy where Gandy serves best; conveyors and elevators in particular. Write for full information and sample of belt. Let Gandy do the heavy work.

THREE TYPES: Gandy Stitched Cotton Duck Belting, for ordinary indoor work. Thermo-Gandy, specially treated for outdoor installations and extremes of heat, cold, steam, etc. Gandy Wax-Impregnated Belt; white, washable, for conveying food products in bulk.

TRADE MARK GANDY'S AMERICAN COTTON BELTING REG. U.S. PAT. OFF.

GANDY

The name "Gandy" is not a generic term covering all Stitched Cotton Duck belt. It is the trade marked name designating *only* the product of the Gandy Belting Company of Baltimore, Maryland, who originated this type of belting in 1880. Gandy Belt is distinguished by the green edge and the Gandy trade mark.

THE
GANDY BELTING
COMPANY
762 WEST PRATT STREET
BALTIMORE, MARYLAND
NEW YORK CHICAGO

Trade Publications

Foote IXL Flexible Couplings is the title of a new bulletin, issued by Foote Bros. Gear & Machine Co., Chicago, Ill., devoted to a brief description of the different types of IXL flexible couplings and advantages claimed for different purposes. The bulletin also includes tabulated data of shaft sizes, dimensions, weights and prices.

Reducing Motor Speeds with Efficiency, Economy and Safety is the title of a folder describing the best method of stepping down electric motor speeds by means of Foote Bros. IXL Speed Reducers, dust proof and fool proof.

The Atlas Powder Co., Wilmington, Del., has recently issued a folder describing and illustrating its blasting supplies, under the heading *Atlas Blasting Supplies.* The Atlas company claims not only to make a proper explosive for every blasting requirement, but also to manufacture blasting supplies that are made especially for use with every form of explosive.

Jones Gears is the title of a new catalog, No. 29, just issued by the W. A. Jones Foundry & Machine Co. of Chicago. This catalog contains 224 pages of specific detailed information, with illustrations, regarding the Jones gears of every kind, shape and manner.

The Hill Clutch Machine & Foundry Co., Cleveland, Ohio, has just issued bulletin *T-220*, descriptive of industrial type spur gear speed transformer. It is a 6-page bulletin, 6 in. x 9 in. in size, describing the new equipment designed for use in cement mills and other industrial plants in connection with conveyor drives and for all general industrial work where speed transformer units are operated under continuous or heavy service conditions. The advantages claimed for this type of speed transformer are listed and general dimensions for the seven sizes are included.

IXL Speed Reducers is the title of catalog No. 25 issued by Foote Brothers Gear and Machine Co., Chicago, Ill. This catalog which has just been issued is 8½ x 11 in. and contains 30 pages; it is profusely illustrated by reproductions of photographs and drawings showing speed reducers, flexible couplings, head plate mountings, and replacement parts for the various kinds of equipment mentioned. The speed reducers include both spur gear and worm gear reducers. Numerous illustrations show actual installations of the equipment in various plants, including a number of cement mill installations. Useful information is also included concerning ratios, weights and formulae for calculating horsepower and torque, and designing castings.

In bulletin No. 1461, issued by the Allis-Chalmers Manufacturing Co., the Superior McCully fine reduction gyratory crusher is described with particular attention to the special features claimed for that equipment.

The top shell is reversible and by reversing the shell double wear is obtained from the concave. Sectional views are included in the bulletin showing the automatic lubrication of the eccentric and gearing.

A Chain of Evidence, publication No. 26A has been issued by the Morse Chain Co., Ithaca, N. Y., descriptive of small power drives. This is an illustrated booklet, 6 in. x 9 in., 24 pages, with paper cover.

Morse silent chain drives in connection with various machine installations are described and illustrated. Considerable information is included on general design, adjustment and lubrication of chain drives.

The company has also issued an extremely interesting booklet under the heading *Power, Its Application from the 17th Dynasty to the 20th Century.* This booklet describes and illustrates the evolution of mechanical devices for power transmission.

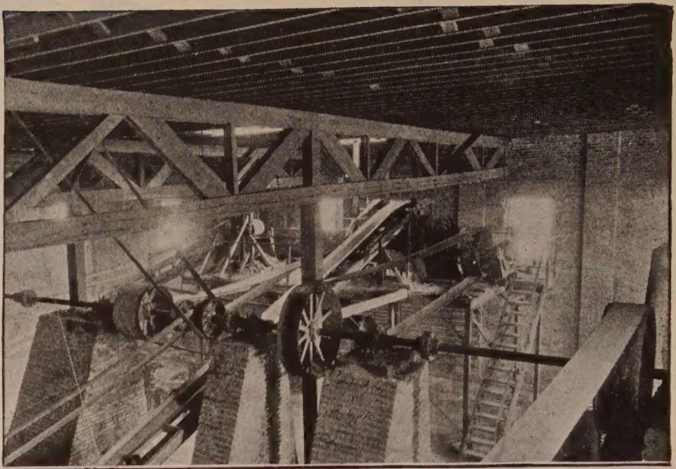
Material Handling Equipment is described in bulletin No. 98, issued by the Gifford-Wood Co., Hudson, N. Y. The Gifford-Wood equipment including elevators and conveying equipment, coal-handling equipment, wagon loaders, portable belt conveyors, electric capstan car pullers, friction clutches, hoists, sheet steel work, chains, sprockets, chutes and screens.

The bulletin which is 8½ in. x 11 in. is devoted largely to descriptive material and illustrations of elevators and conveyors for facilitating manufacturing processes.

The Atlas Valve Co., 282 South St., Newark, N. J., has just issued Edition No. 1 of Bulletin 5-A entitled *Victor Damper Regulators.* The functions of damper regulators are fully listed under nine separate headings. Hydraulic operation as compared with other methods of operation is carefully treated. The uses of damper regulators in connections with all boiler pressures are covered in detail under:

1—Low Pressure or Vapor Heating
2—Medium Pressure
3—High Pressure Power Boilers

Diagrams show how to apply the regulators to boilers. A complete technical description is given with illustrations explaining in detail the method of operation of the high pressure damper regulator which is provided with a novel compensating device. A copy will be mailed to any reader of this publication on request.



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